

# Appendix F

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Selection of Radon Gas Background Area to  
the Residential Milan Area Adjacent to HMC

Gkhoury

January 20, 2011

Subject: Selection of background radon Criteria for Homestake Mining Co.  
Subdivision Communities:

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Selection of a true background area is a major task undertaken in developing human health risk assessment. It is an essential element or part of the risk assessment needed for proper evaluation of the impact of site related chemicals or radio nuclides on communities surrounding a superfund site. The following is my evaluation of the background areas for the Homestake Mining Co. subdivision communities.

**Summary:**

After consultation with USGS, it was found that it is very challenging to select an area that can be called a true background for the Homestake subdivisions based solely on geological information. A true background is an area that has not been impacted by site releases or other sources of contamination. Therefore, EPA region 6 developed the following criteria to determine a true background:

**1. Aerial Reconnaissance**

Review EPA's ASPECT (Airborne Spectrophotometric Environmental Collection Technology) aerial photo scan to eliminate areas that show high gamma scan counts because of nearby mines or high uranium deposits.

**2. Geological Features**

Consult with USGS in evaluating the geology of the selected areas.

**3. Soil Type**

Evaluate the soil of the area up to two meter below ground surface.

**4. Site Reconnaissance**

Tour the selected areas and evaluate the background community on the basis of rural vs. urban, type of the stock of housings, demographic makeup and distance from potential sources of radiation.

**5. Historical Research**

Review older studies and evaluate background areas used in those older documents.

**6. Radiological Scanning**

Conduct gamma scan screening of selected areas with hand-held sodium iodide detectors.

The following surrounding areas and communities were evaluated for the above mentioned criteria:

- 1) The Spanish Land Grant area including Seboyeta, Moquino, Bibo, and Paguate located approximately 29 miles east of the HMC subdivisions;
- 2) Prewitt community located 12.6 miles northwest of HMC;
- 3) Bluewater community located about 6.4 miles west of HMC subdivisions;
- 4) San Rafael community located about 8.8 miles south of HMC subdivision;
- 5) Grants community between Lobo Canyon Road and Roosevelt avenue located at about 5.3 miles southeast of HMC subdivision; and
- 6) San Mateo community located about 13.4 miles northeast of HMC subdivision.

The Seboyeta, Moquino, Bibo and Paguate were eliminated from further consideration since they are too far from the site and are close to Uranium deposits. San Mateo community area appear to be influenced by nearby mining areas as shown by the ASPECT aerial scan and were eliminated from further evaluation. Prewitt did not have developed subdivisions like HMC subdivisions and failed to meet the required number of houses needed for our evaluation. San Rafael community had very old houses and the housing stock was different from the HMC subdivision houses. The community in Grants which was suggested by USGS appears to be geologically similar to HMC subdivisions (the area is bounded by Lobo Canyon Road and Roosevelt avenue), looked more urban than rural with houses too close to each other with asphalt and concrete pads. The only other community that is close enough to the HMC subdivisions is the Bluewater Village. The community in Bluewater closely resembles HMC subdivisions with respect to type of subdivision layout and home construction. Further, Bluewater Village community has been used for previous radon studies and the data evaluation from this indicates radon levels that resemble a true background area.

Based on these observations Bluewater Village meets the criteria for true background more than the other communities that were evaluated. Therefore the community at Bluewater was selected to represent a true background area for the HMC subdivision.

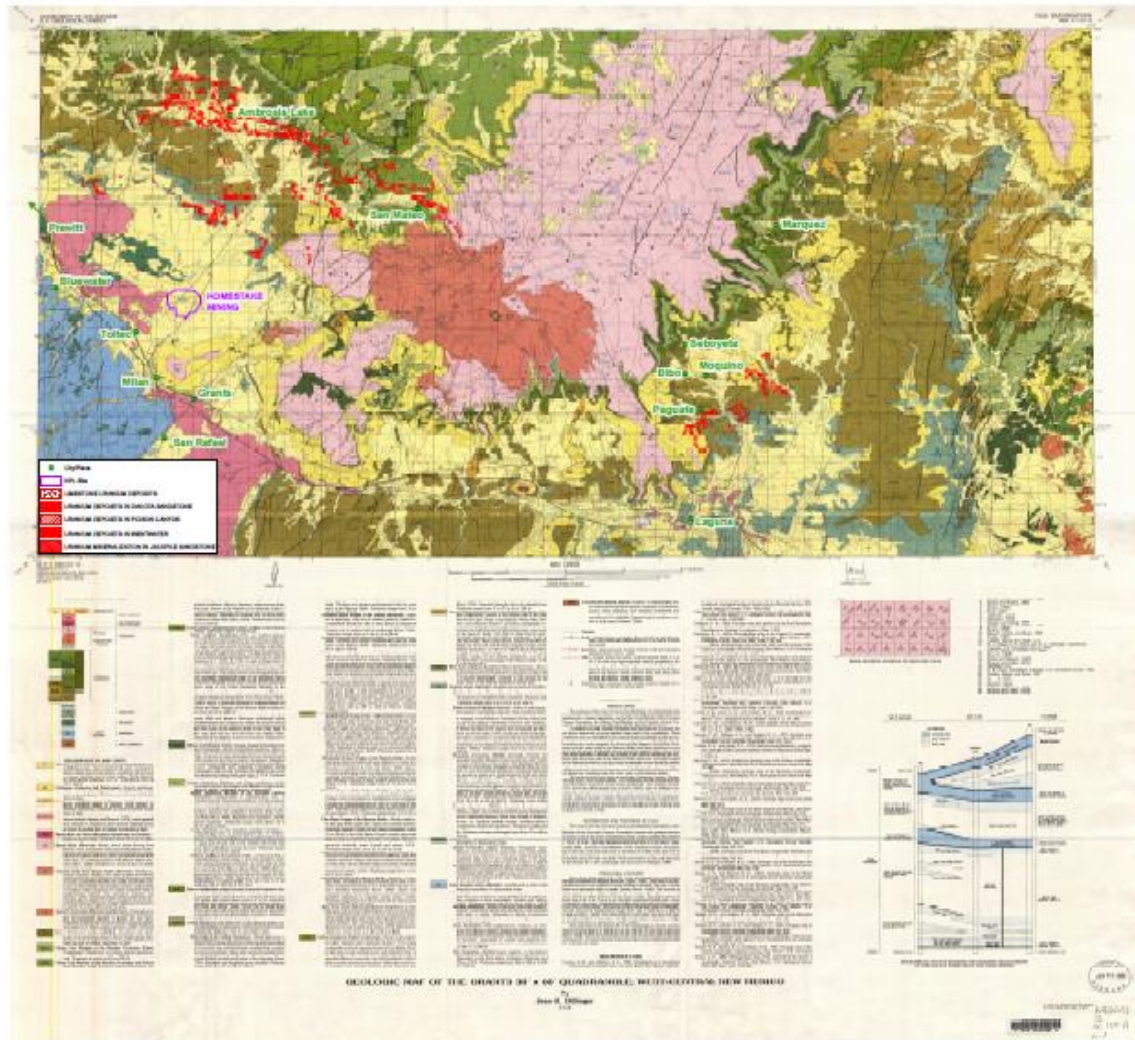
### **Background:**

EPA region 6 was aware early on when scoping for developing a human health risk assessment for the HMC subdivision site that selection of a true background for radon gas at the HMC subdivision would be very difficult and challenging. EPA sought help and consultation from USGS, NMED, and technical consultants to the community.

### **Process of Background Selection:**

1) Communities were first selected by reviewing Geological Map of the Grants 30' X 60' Quadrangle, West-Central New Mexico (see Figure 1 below) and selecting those communities that are in close vicinity to the site and within the same map unit as the HMC subdivisions. The map unit where these communities were selected is described as alluvium, eolian deposits, and associated valley fill ( Holocen and Pleistocene)- Unconsolidated silt, sand, and gravel in stream valleys and on flood plains, windblown silt and sand on mesas, benches and in broad valleys. It is partly dissected by recent gullies. Thickness is as much as 15 m (50 ft).

The Spanish Land Grant area (Seboyeta, Moquino, Bibo, and Paguete) was eliminated based on this map which show uranium deposits in close proximity to areas with communities on them and is very far from HMC subdivision area.

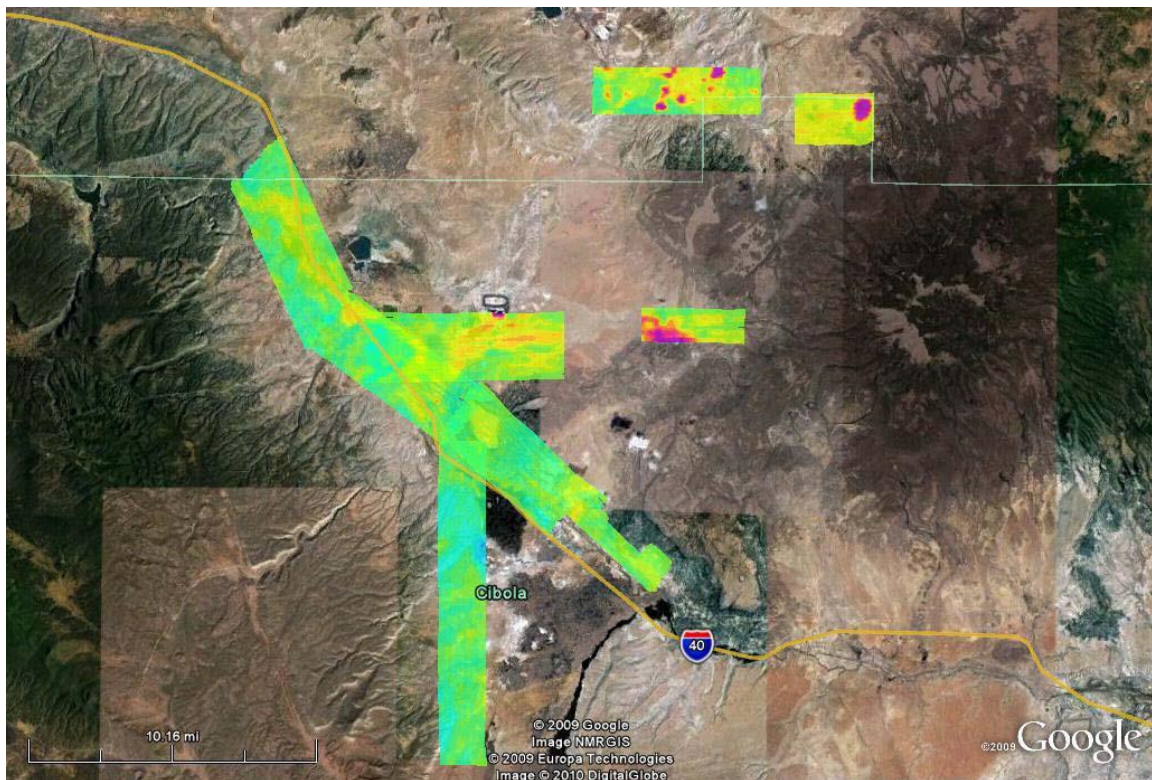


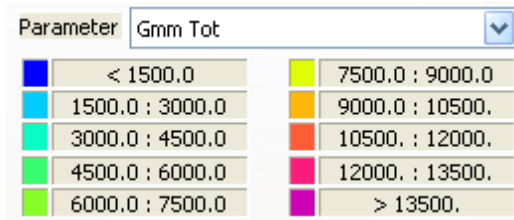
**Figure 1: Geologic Map of the Grants 30' x 60', West Central New Mexico**

2) In September 2009, EPA Region 6 requested that the National Decontamination Team ASPECT program conduct aerial surveys of about 120 square miles of residential and near residential areas in the Ambrosia Lake and Laguna sub-districts of the Grants Mineral Belt in New Mexico and identify areas where surface uranium concentrations were out of balance with the surrounding environment. The survey was completed between October 7 and October 15, 2009 (see Figure 2 below). Several products were delivered and included contour plots of (1) total count rate in counts per second (cps), (2) uranium concentration in picocuries per gram (pCi/g), (3) exposure rate in microRoentgen per hour ( $\mu$ R/hr), and (4) a plot of individual data points color coded for statistical significance representing deviation from normal background conditions. Additionally, about 1,100 high resolution digital photographs were taken over the entire survey area. All these data are available in a Google Earth format so any user can dynamically review the data in higher resolution.

These aerial surveys were used to evaluate background locations. San Mateo community was eliminated based on this map. There is a stream of high gamma readings originating from mount Taylor to the community.

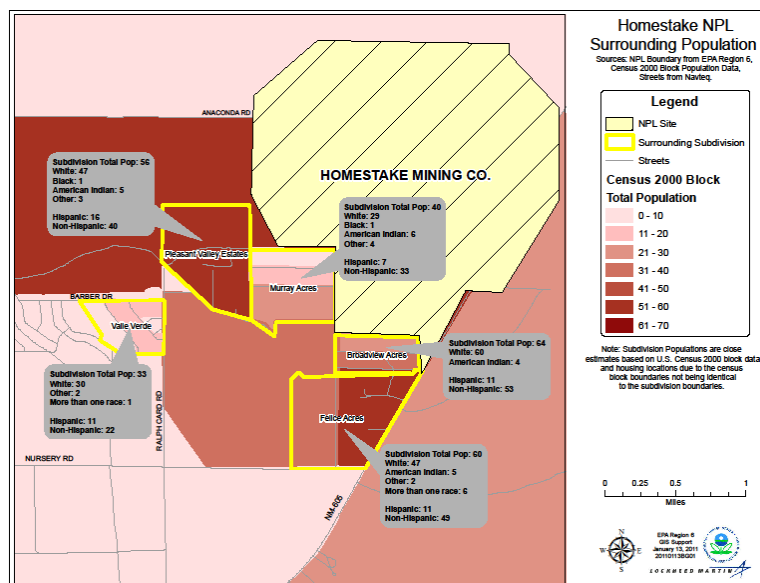
**Figure 2**  
**Grants Area Survey**  
**Gamma Count Rate Contour Map**  
**October 7- 12, 2009**



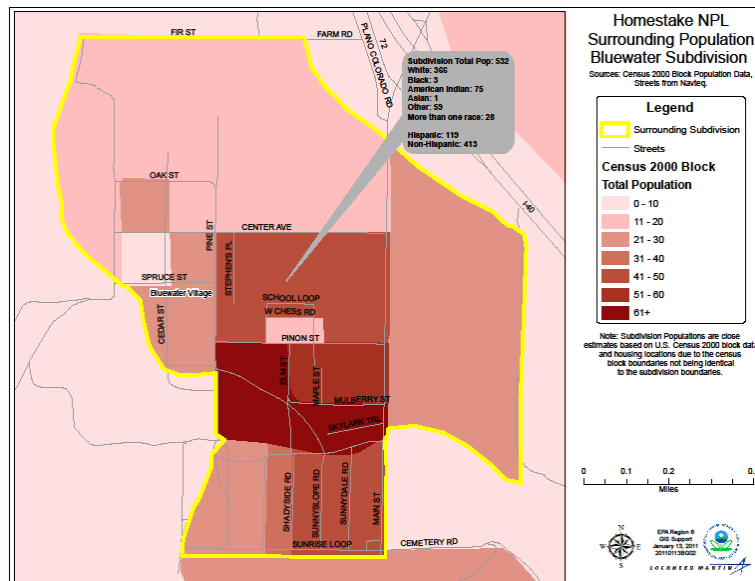


3) On September 09, 2010 the remaining selected areas were toured by driving and observing through each community the housing structures in these areas. Also we observed the location of the areas with respect to HMC Subdivision, make up of the population (see Figure 3 and Figure 4 below), presence of mining or milling operations, and whether the area is rural or urban communities. Bluewater community was found to be somewhat similar to HMC subdivision community. Typical homes that were observed were trailers, manufactured homes and frame with stucco homes similar to the homes in the subdivisions near the HMC site. The homes appear to be built almost in the same time frame as HMC subdivision homes. The nearby Anaconda mill was reclaimed and covered and radon data from other studies which used Bluewater as a background did not show Anaconda mill to impact the Bluewater community.

This tour was one factor in our decision to eliminate Prewitt, San Rafael and Lobo Canyon road communities from consideration as a true background location for HMC subdivision and confirmed our selection of Bluewater.



**Figure 3: Demographics of the subdivisions south of HMC facility from Census 2000**



**Figure 4: Demographics of Bluewater Village from Census 2000.**

4) Previous studies that used background locations in this area were reviewed. A study of interest titled “Radiological Assessment of the populated Areas Southwest of the Homestake Mining Company Uranium Mill” authored by Millard, J.B. and Buggett, D.T. 1984 refers to using San Mateo and Bluewater as background outdoor radon locations. Concentrations of outdoor radon in these background locations were reported to be  $0.32 \pm 0.02$  pCi/l from a total of 52 measurements. Background indoor radon was measured in five local background structures and averaged  $1.84 \pm 0.15$  pCi/l. Of these five, two were located in Grants and one each in Milan, Bluewater and San Mateo. Two of those were in schools, two were in private homes and one was located in an office building.

Another study titled “Radon and Radon Decay Product Concentrations in New Mexico's Uranium Mining and Milling District” authored by Thomas Buhl, Jere Millard, David Baggett, Sue Trevathan, Radiation Protection Bureau, Environmental Improvement Division, New Mexico Health and Environment Department, Final Report, March 1985 report concentration of outdoor radon in background areas (Bluewater Lake, Cebolleta, Crownpoint, Gulf Mill Site, Nose Rock and San Mateo) averaged  $0.19 \pm 0.02$  pCi/l from 115 measurements.

A study titled “Preliminary Geologic Radon Potential Assessment of New Mexico” authored by Russell F. Dubiel USGS Open-File Report 93-292-F, reports that the indoor radon concentration in Cibola and Valencia counties as a Geometric mean of 1.8 with a

standard deviation of 1.5 and 1.8 with standard deviation of 0.8 respectively. Seventeen percent of the samples were > 4 pCi/L in Cibola and 0% of the samples > 4pCi/l in Valencia. These studies confirmed our selection of Bluewater as a good candidate for a true background location.

#### 5) USGS Evaluation of the area by Jim Otton with USGS.

The following is a synopsis of emails received from Jim Otton with USGS on his evaluation of the geology of the area and his thoughts on our search for a true radon background location for the site.

“I have evaluated the geology of the area of the 5 subdivisions south and southwest of the Homestake mill site. The Felice Acres, Broadview, and the east half of the Murray Acres subdivision are on the Grants 7.5 minute quadrangle for which there is geologic mapping to be found at [http://ngmdb.usgs.gov/ngm-bin/ILView.pl?sid=1990\\_1.sid&vtype=b](http://ngmdb.usgs.gov/ngm-bin/ILView.pl?sid=1990_1.sid&vtype=b) (Thaden, R.E., Santos, E.S. and Raup, O.B, 1967, Geologic map of the Grants quadrangle, Valencia County, New Mexico: U.S. Geological Survey, Geologic Quadrangle Map GQ-681, scale 1:24000). To the west is the Milan 7.5 minute quadrangle which has no published geologic map although the State of New Mexico is presently mapping in that area (Mike Timmons would be a contact). The west half of the Murray Acres subdivision and the Pleasant Valley and Valle Verde subdivisions are on the Milan quadrangle. The existing mapped geology and aerial photo features of all five subdivisions suggest that they are located primarily on “Qal” or alluvial deposits comprised mostly of silt and sand with small areas of dune sand. The presence of irregular depressions and washes that terminate in the area suggest a low topography with poorly integrated drainage. This can be confirmed in the Google-Earth imagery. Shallow caliche layers very likely occur in the soil profile.

The alluvium would mostly be derived from outcrop of the Todilto Limestone and related sedimentary rocks plus basalts of the La Jara Mesa to the north and east, from outcrops of the Chinle Formation to the westnorthwest, and from sediment carried downstream along San Mateo Creek from greater distances. Small open-pit uranium mines occur on the low mesas underlain by the Todilto limestone 4-6 miles to the east and north of the subdivision area. (See Thaden, R.E., Santos, E.S. and Ostling, E.J., 1967, Geologic map of the Dos Lomas quadrangle, Valencia and McKinley Counties, New Mexico: U.S. Geological Survey, Geologic Quadrangle Map GQ-680, scale 1:24000 AND Thaden, R.E. and Ostling, 1967, Geologic map of the Bluewater quadrangle, Valencia and McKinley Counties, New Mexico: U.S. Geological Survey, Geologic Quadrangle Map GQ-679, scale 1:24000).

I spoke with Virginia McLemore of the New Mexico Bureau of Geology and Mineral Resources (the uranium resource specialist) and she suggested housing areas to the northeast of Grants (the Lobo Canyon Road area). A review of the geology of the area (see the first map above) shows enough similarities to suggest that it may be acceptable. The topography in the Grants suburbs area south of Lobo Canyon Wash is relatively flat,

sloping gently to the south-southwest at about 1%. A low mesa underlain by the Todilto limestone occurs to the east about 1 mile. Small uranium deposits occur there. The alluvium appears to be dominated by material coming out of Lobo Canyon. Mesozoic sedimentary rocks, basalt and some rhyolite occur in the Lobo Canyon drainage. The area is removed from any milling activity. It seems very unlikely that waste piles associated with the small Todilto uranium mines would contribute any sediment or dust to the soils in the housing areas to the west. The subdivisions in the triangular area bordered by Roosevelt Road to the south, Sakelares Road to the east and Lobo Canyon Rd to the northwest should provide enough single-family houses for a comparison (street names from the Google Earth imagery). The soils in this area may be generally coarser grained than in the 5 subdivision area, but what effect this may have on indoor radon levels is not predictable. Caliche layers likely occur in the shallow soil profile. Note that northeast suburban Grants areas north of Lobo Canyon Wash may be dominated by basaltic rock coming off of the Grants Ridge basalt flow.

Note also that studies of outdoor radon and indoor radon progeny in the Grants area were done by the EPA in the mid 1970s and indoor radon by the New Mexico Health and Environment Department in the mid to late 1980s. The latter studies likely include data for the Grants region.

There is good geologic mapping available for both the Bluewater (see reference below) and San Mateo areas (Santos, E.S., 1966, Geologic map of the San Mateo quadrangle, McKinley and Valencia Counties, New Mexico: U.S. Geological Survey, Geologic Quadrangle Map GQ-517, scale 1:24000).

The Village of Bluewater is located primarily on Qal (alluvium) on the west side of the floodplain of Bluewater Creek at the mouth of two small streams that drain the northeastern flank of the Zuni Mountains. Low hills immediately to the west are underlain by the San Andreas Limestone and Moenkopi Formation. Alluvium underneath these residences is likely derived from these two small drainages and from flood-deposited sediment derived from the larger Bluewater Creek drainage which includes a diverse suite of rock types, although rocks similar to those of the San Mateo Creek are less well represented in the Bluewater Creek drainage. The slopes on the floodplain are something less than 1% whereas near the mouth of the two small streams it may be a little more. The water table may not be very deep and there are several irrigated fields adjacent to the housing areas.

I note that the disturbed ground and covered tailings piles associated with the Anaconda-Bluewater mill are as close as 1.4 miles eastnortheast of the edge of the village. This may or may not be a factor in indoor radon in Bluewater residences.

San Mateo is located at the foot of the west flank of Mt. Taylor, the large basaltic stratovolcano that dominates much of the area. The geologic map and the color aerial images suggest that residences of San Mateo are situated on colluvium and alluvium derived from the pale yellowish brown siltstone and sandstones of the Menafée Formation and on alluvial soils derived, at least in part, from the basaltic rocks of the high hills to the east that have come out of the mouth of San Mateo Canyon. The soils

slope 3-4% westerly. This diversity in geology may add a source of variability to the radon data. The water table is likely fairly deep. Some residences on the northeast edge of town are about 900 feet from the disturbed ground associated with the Mt. Taylor uranium mine although most are at least 1400 feet from it. The mine complex occupies an area about 3200 feet N-S and 1700 feet E-W. Again, this may or may not be a factor in indoor radon in San Mateo residences. The mine is not presently active and is on standby status.

Your mention of water supply raises a possible additional source of indoor radon variability. Public water supplies generally carry low radon levels whereas private wells can have highly variable radon. A crude rule of thumb is that 10,000 pCi/L of radon in the water supply can contribute about 1 pCi/L of radon to indoor air. I would not measure radon in water during your study but if a home has very high indoor radon, one source to check may be the water supply.

There is enough diversity in the geology of all these proposed additional sampling areas that it is likely difficult to define a “true background” for indoor radon. Sampling in one or more of these other areas will provide a basis of comparison to the Homestake subdivisions, but if the differences are slight it may be difficult to demonstrate any effect from the Homestake mill site on indoor radon levels. Moreover, there are so many geologic, radiochemical, soil gas transport, slab age and condition, HVAC system, house structure, and usage factors that influence indoor radon levels that substantial variability is to be expected.

I would like to suggest an additional approach. If your working hypothesis is that airborne dusts from the mill site and all operations related to it have contributed sufficient radium to soils that there may be elevated indoor radon and gamma exposure in the five subdivisions, then establishing whether a pattern of elevated gamma activity in the soils surrounding the mill site exists should be an important step. This could be done by systematically making gamma spectrometer measurements 360 degrees around the mill site and calculating equivalent radium (eRa) activity for the soils. Note that this data would only provide information for the approximately upper 40 cm of the soil horizon but since dust deposition is the primary mechanism for soil contamination and radium has limited downward mobility, it should provide key indications. These readings could be compared to baseline readings taken at sites more distant from the mill, but still in the San Mateo Creek drainage. This gamma survey could be done concurrently with the indoor radon and gamma survey of the 5 subdivisions. Such a gamma survey may be necessary, in any event, if high indoor radon readings and elevated gamma levels are found within the 5 subdivision areas. It might be argued that these high values only reflect local variation unless a soil “dust plume” traceable back to tailings piles locations can be reasonably demonstrated.”

Jim Otton

## **6) Soil Type for the Region taken from Davis California site.**

### **SAN MATEO SERIES**

The San Mateo series consists of very deep, well drained, moderately slowly permeable soils that formed in alluvium, fan alluvium and stream alluvium from mixed sources on alluvial fans on valley sides and flood plains on valley floors. Slopes are 0 to 5 percent. Average annual air temperature is about 52 degrees F. Average annual precipitation is about 11 inches.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

**TYPICAL PEDON:** San Mateo loam -- rangeland. (Colors are for dry soil unless otherwise noted.)

**A**--0 to 2 inches; light yellowish brown (2.5Y 6/4) loam, olive brown (2.5Y 4/4) moist; moderate fine granular structure; soft, friable, nonsticky and nonplastic; common fine and very fine roots; strongly effervescent; slightly alkaline; abrupt smooth boundary. (1 to 12 inches thick)

**C1**--2 to 12 inches; light olive brown (2.5Y 5/4) loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; 5 percent pebbles; strongly effervescent; slightly alkaline; clear smooth boundary.

**C2**--12 to 29 inches; light olive brown (2.5Y 5/6) sandy clay loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine irregular pores; 5 percent pebbles; strongly effervescent; slightly alkaline; gradual smooth boundary.

**C3**--29 to 70 inches; light olive brown (2.5Y 5/6) sandy clay loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine irregular pores; 5 percent pebbles; strongly effervescent; slightly alkaline. (Combined thickness of the C horizon is greater than 40 inches.)

**TYPE LOCATION:** Cibola County, New Mexico, Moquino Quadrangle; about 1 mile northwest of Moquino, New Mexico, at 35 degrees, 11 minutes and 10 seconds north latitude, and 107 degrees, 18 minutes and 21 seconds west longitude.

### **RANGE IN CHARACTERISTICS:**

Soil Moisture: Intermittently moist in some part of the soil moisture control section December through March and July through October. The soil is driest during May and June. Ustic aridic soil moisture regime.

Soil Temperature: 51 to 57 degrees F.

Reaction: slightly to strongly alkaline

Carbonates: effervescent throughout

Salinity EC: 1 to 8 dS/m

Control section weighted average: 18 to 35 percent clay and more than 15 percent fine sand or coarser

A horizon

Hue: 10YR, 2.5Y

Value: 5 or 6 dry, 3 through 5 moist

Chroma: 2 through 6, dry or moist

Texture: sandy loam, fine sandy loam, loam, sandy clay loam, silt loam, silty clay loam, clay loam

When the surface mantle has colors and organic carbon content of a mollic epipedon, it lacks the thickness requirements.

C horizon

Hue: 10YR, 2.5Y

Value: 5 or 6 dry, 3 through 5, moist

Chroma: 2 through 6, dry or moist

Textures: stratified sandy loam, fine sandy loam, loam, sandy clay loam, silt loam, silty clay loam, clay loam

Sodic SAR: 5 to 30

**COMPETING SERIES:** These are the [Barnum](#) (WY), [Haverdad](#) (WY), [Haversid](#) (CO), [Manikan](#) (AZ), [Panitchén](#) (CO) and [Suwanee](#) (NM) series. Manikan and Suwanee soils have hue of 7.5YR and redder. Panitchén soils have gypsum accumulations. The Barnum, Haversid, and Haverdad soils are moist in the soil moisture control section during [May](#) and June.

**GEOGRAPHIC SETTING:** The San Mateo soils formed in alluvium, fan alluvium and stream alluvium from mixed sources on flood plains on valley floors, and alluvial fans on valley sides. Slopes are 0 to 5 percent. Elevations range from 5,200 to 7,800 feet. The mean annual air temperature is 49 to 54 degrees F. The average annual precipitation is 9 to 14 inches. Peak precipitation occurs in July, August, September and October. The frost-free period is 120 to 180 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the [Sparank](#) soils. Sparank soils have more than 35 percent clay in the control section.

**DRAINAGE AND PERMEABILITY:** Well drained, low to medium runoff, and moderately slowly permeability.

**USE AND VEGETATION:** This series is used for livestock grazing. The present vegetation is alkali sacaton, western wheatgrass, blue gram, fourwing saltbush, and galleta.

**DISTRIBUTION AND EXTENT:** Northwestern New Mexico, Arizona and Utah. MLRAs 35 and 36, LRR-D. This series is of large extent. This series does not occur outside of MLRA 35 and 36.

**MLRA OFFICE RESPONSIBLE:** Phoenix, Arizona

**SERIES ESTABLISHED:** Cibola County, New Mexico, 1956

**REMARKS:** Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - the zone from 0 to 2 inches (A horizon)

Fluventic feature - an irregular decrease in organic carbon due to stratification

Classified according to Soil Taxonomy, Second Edition, 1999; Keys to Soil Taxonomy, Tenth Edition, 2006.

Updated and revised for the correlation of Ft. Defiance Area AZ715 2/08 DWD

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National Cooperative Soil Survey  
U.S.A.

## **APAREJO SERIES**

The Aparejo series consists of very deep, well drained, moderately slowly and slowly permeable soils that formed in alluvium derived from sandstone and shale. Aparejo soils are on flood plains and alluvial fans. Slope is 0 to 5 percent. Mean annual precipitation is about 13 inches and mean annual temperature is about 51 degrees F.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive, calcareous, mesic Aridic Ustifluvents

**TYPICAL PEDON:** Aparejo silt loam--rangeland. (Colors are for dry soil unless otherwise noted.)

A--0 to 2 inches; yellowish red (5YR 4/6) silt loam, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common medium and fine and few very fine roots; few very fine irregular pores; strongly effervescent; calcium carbonate disseminated; moderately alkaline; abrupt smooth boundary. (2 to 6 inches thick)

C1--2 to 18 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; massive; soft, very friable, slightly sticky and nonplastic; few medium, fine and very fine roots; common very fine irregular pores; strongly effervescent; calcium carbonate is disseminated; moderately alkaline; clear smooth boundary. (10 to 30 inches thick)

C2--18 to 60 inches; yellowish red (5YR 5/6) dominantly silt loam with thin strata of fine sandy loam and very fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine irregular pores; strongly effervescent; calcium carbonate is disseminated; moderately alkaline.

**TYPE LOCATION:** Cibola County, New Mexico; Mesa Aparejo Quadrangle; about 3 miles northwest of Mesa Aparejo; 400 feet north and 2,165 feet east of the SW corner of sec. 28, T. 6 N R 3 W.

#### **RANGE IN CHARACTERISTICS:**

Soil Moisture: Continuously moist, in most years, in some part of the soil moisture control section November through April and intermittently moist July through October. The soil is driest during May and June. Aridic ustic soil moisture regime.

Soil temperature - 50 to 56 degrees F.

Control section - Texture: Stratified silt loam, silty clay loam, clay loam and sandy clay loam. Lenses of sand to silt less than 1 inch thick occur.

Clay content: 18 to 35 percent

Fine sand or coarser content: More than 15 percent.

A horizon -

Hue: 2.5YR or 5YR

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 4 or 6

Texture: silt loam, clay loam or clay.

C horizon -

Hue: 2.5YR or 5YR

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 4 or 6

**COMPETING SERIES:** These are the [Haverson](#) (CO), [Hickman](#) (NM), [Hysham](#) (MT), [Ramper](#) (CO) and [Rockypoint](#) (WY) series. Haverson, Hickman, Ramper, and Rockypoint soils have 7.5YR or yellower hues. Hysham soils are strongly or very strongly alkaline with pH greater than 8.5. In addition, Haverson, Hysham, and Rockypoint soils are in LRR-G and are more moist in [May](#) and June.

**GEOGRAPHIC SETTING:** Aparejo soils formed in alluvium from sandstone and shale and are on flood plains and alluvial fans. Slopes are 0 to 5 percent. Elevations range from 6,100 to 7,500 feet. The mean annual precipitation is 13 to 16 inches and the mean annual temperature is 49 to 54 degrees F. The frost-free period is 115 to 140 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the [Atarque](#), [Bond](#), [Flugle](#), [Galestina](#), [Hagerman](#), [Laporte](#), [Nogal](#), [Penistaja](#), [Rizozo](#), [Rana](#), [Teco](#) and [Venadito](#) series. Atarque, Bond, Flugle, Galestina, Hagerman, Nogal, Penistaja and Teco soils have argillic horizons. Laporte and Rizozo soils have lithic contacts within 20 inches. Rana and Venadito soils have more than 35 percent clay in the control section.

**DRAINAGE AND PERMEABILITY:** Well drained; medium runoff; moderately slow and slow permeability.

**USE AND VEGETATION:** These soils are used for livestock grazing and as irrigated farmland. Present native vegetation is alkali sacaton, blue grama, burrograss, fourwing saltbush and western wheatgrass.

**DISTRIBUTION AND EXTENT:** West central New Mexico. MLRA 35 LRR-D. This series is of small extent.

**MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE:** Phoenix, Arizona

**SERIES ESTABLISHED:** Cibola County, New Mexico, 1985.

**REMARKS:** Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - The zone from the surface of the soil to a depth of about 2 inches. (A horizon)

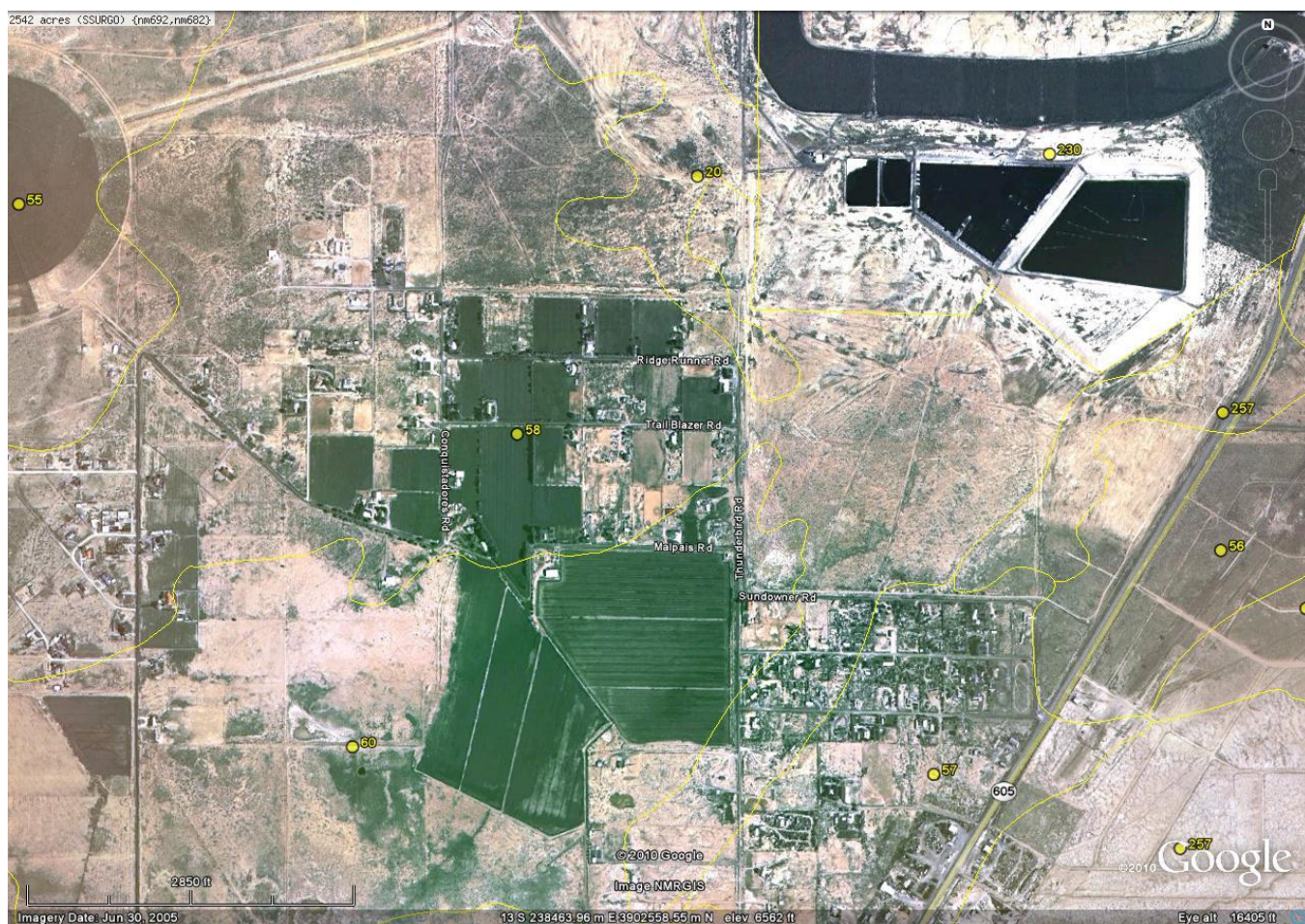
Entisol feature - Lack of diagnostic horizons.

Classified according to Keys to Soil Taxonomy Ninth Edition, 2003.

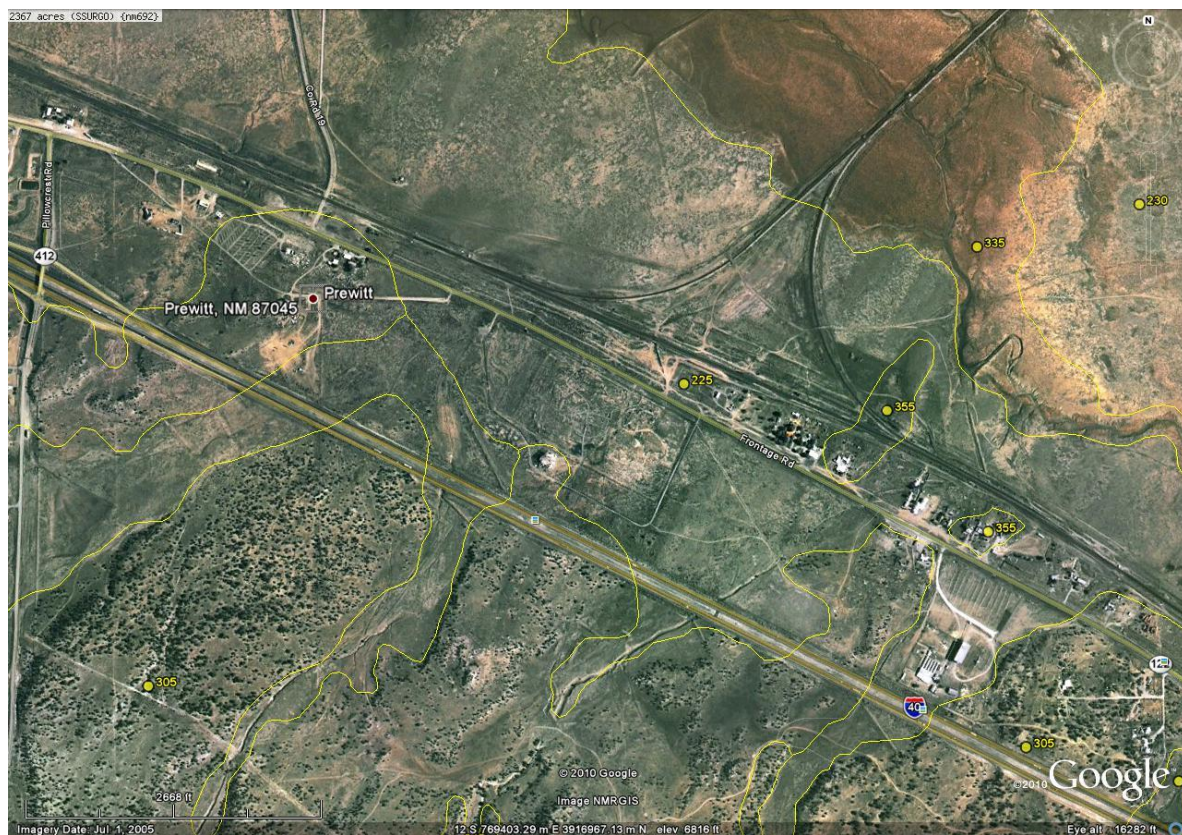
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National Cooperative Soil Survey  
U.S.A.

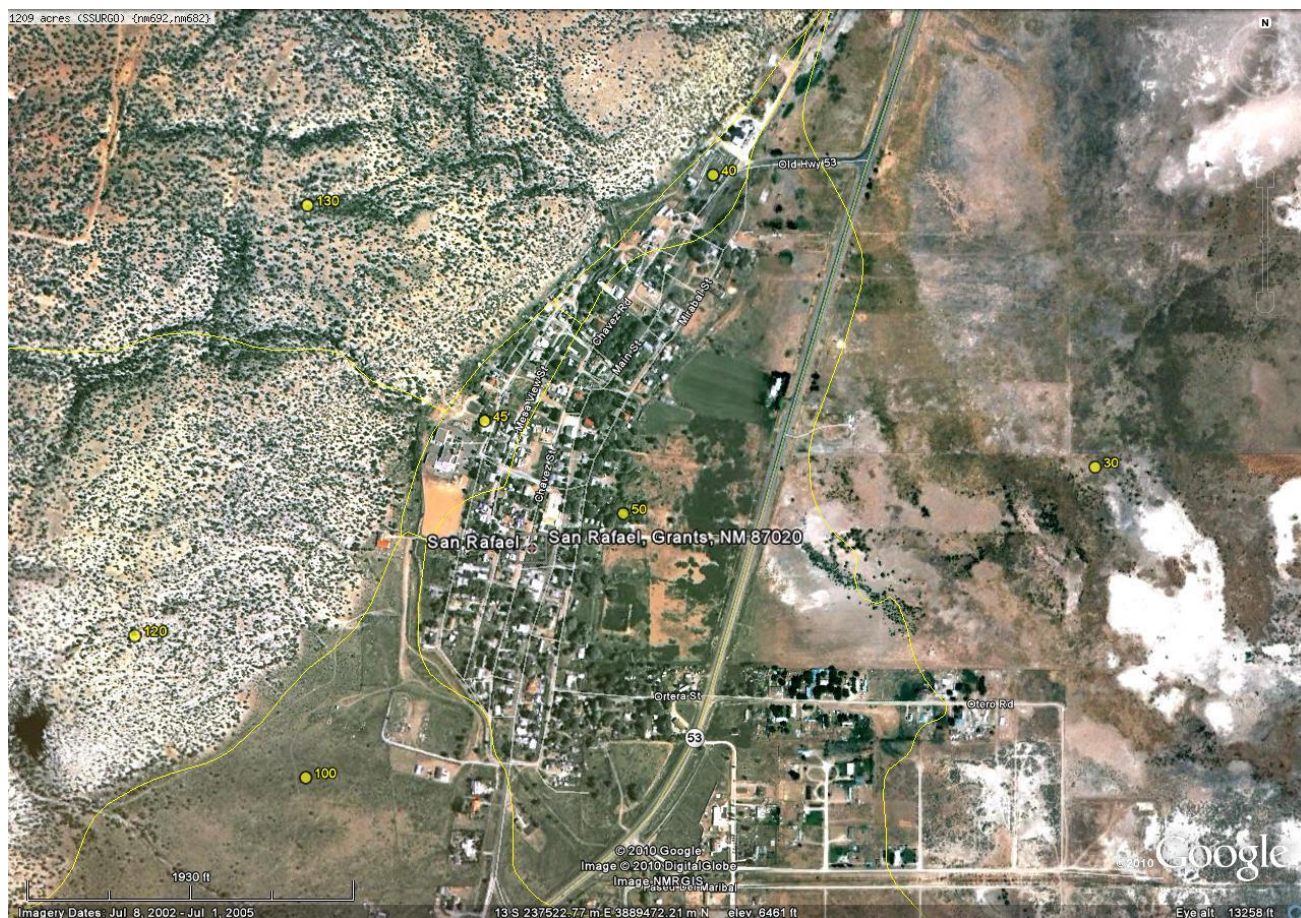
## Google Earth Maps of selected areas with its soil types



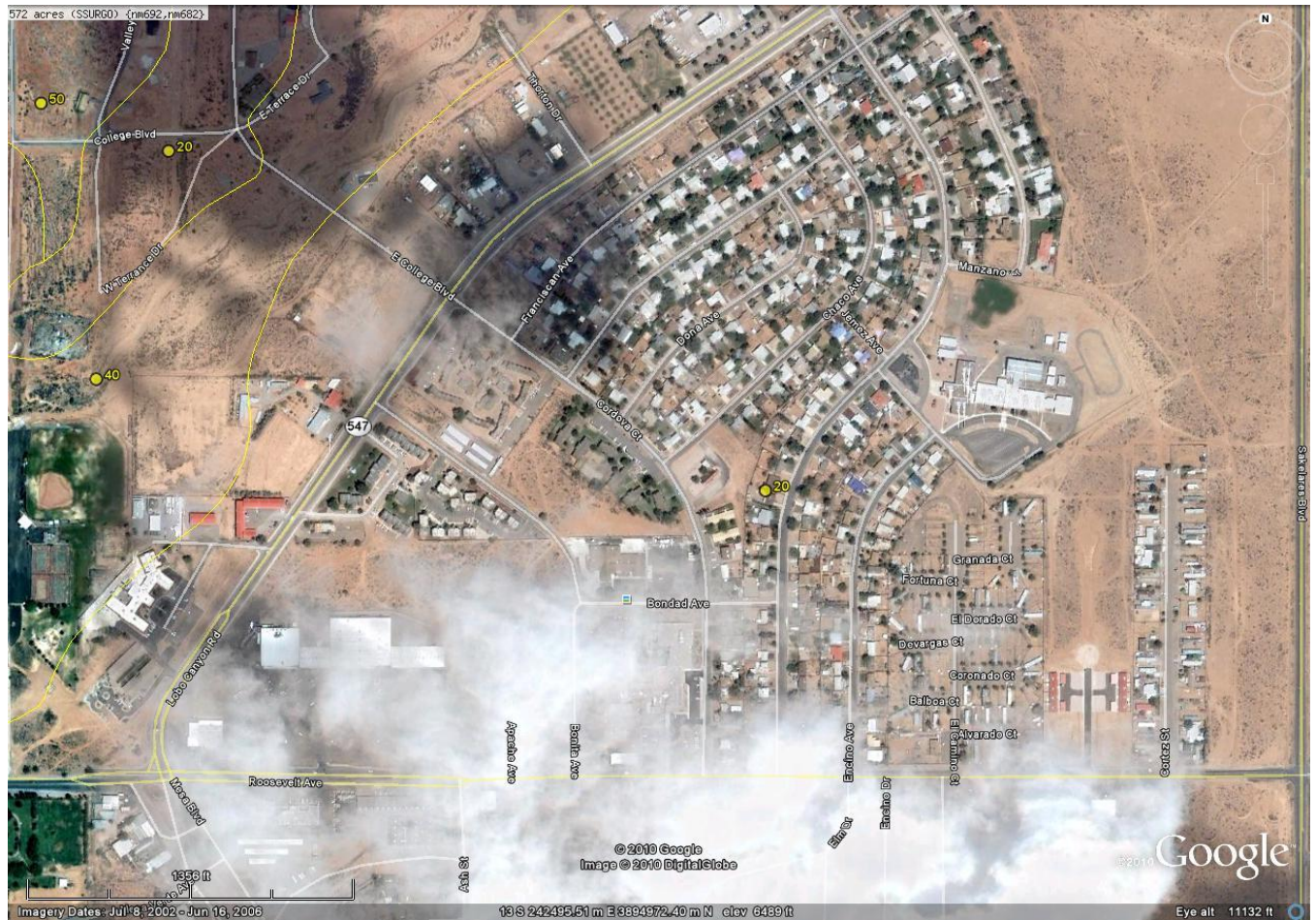
**Figure 5: HMC Subdivisions area. Soil Series 0-178 cm San Mateo clay loam and San Mateo sandy clay loam, 1 to 3 % slope. Alluvial fans.**



**Figure 6: Prewitt, NM. Soil Series 0- 79 cm. Celavar-Atarque complex, 1 to 8% slopes. Aquima-Haxaikuh silt loam, 1 to 5% slope. Alluvial fans.**



**Figure 7: San Rafael, NM. Located south of HMC Subdivision and south of I -40.  
Soil Series 0-152 cm. Venadito clay loam, 0 to 1% slopes flood plains.  
Aparejo clay and Aparejo clay loam 0 to 1% slopes alluvial fans.**



**Figure 8: Area between Lobo Canyon Road and Roosevelt Ave. Located south east of HMC subdivisions in Grants. Soil series 0 – 178 cm. Penistaja fine sandy loam, 1 to 3 % slopes. Fan remnants.**



**Figure 9: San Mateo, Grants NM. Located northeast of HMC subdivisions. Soil series 0 – 178 cm. San Mateo clay loam, 1 to 3 slopes. Sparank clay loam, 1 to 3 % slopes alluvial fans.**



**Figure 10: Bluewater NM. Located west of HMC Subdivisions. Soil series 0 – 152 cm. Aparejo clay loam and Aparejo clay loam sandy substratum, 0 to 1% slopes alluvial fans.**

The soil type of the upper 1 to 2 meters surface soil shows the large differences between locations except for the San Mateo community area which have similar soil type as the HMC subdivision. The top surface soil in the HMC and San Mateo community areas is made up of mostly San Mateo clay loam. But the San Mateo community was eliminated earlier in our evaluation based on potential impact from nearby mines. However, it should be noted that all the areas selected were based on whether the area was overlying alluvium eolian deposits.

## 7) Gamma scan reading results for the selected areas

A hand held NaI 2" X 2" gamma detector was used to take some measurement of gamma emissions in the background selected areas. An area of 100' by 100' was scanned and the following were the results:

Area Scanned	Range of Gamma Readings (CPM)
Prewitt	7,500– 10,000
Bluewater	8,800 – 9,100
Grants	8,500 – 10,000
San Rafael	7,500 – 9,000
San Mateo	11,000- 12,500

The location and reading results are shown in Figure 11 below.



**Figure 11: Gama Scan Readings from Potential Background Locations**

### Conclusion:

Based on all of the above information, EPA region 6 selected Bluewater Village community area as the most representative of a true background area for outdoor and indoor radon levels for the HMC subdivision community. Notwithstanding all of the factors that were considered for the true background location, EPA recognizes that there

are still other local factors (such as age and integrity of the house slabs, movement of air in and out of houses, etc) that is highly variable. The variability in the readings will be assessed and factors associated with this variability will be addressed in the uncertainty section of the risk assessment.

## References

1. Buhl, T., Millard, J.B., Baggett, D., and Trevathan, S., March 1985. Radon and Radon Decay Product Concentrations in New Mexico's Uranium Mining and Milling District. Radiation Protection Bureau, Environmental Improvement Division, New Mexico Health and Environmental Department. Final Report.
2. California Soil Resource Lab. Online Soil Survey.  
[http://casoilresource.lawr.ucdavis.edu/soil\\_web/ssurgo.php](http://casoilresource.lawr.ucdavis.edu/soil_web/ssurgo.php).
3. Dellinger, J.K., 1990. Geologic Map of the Grants 30' X 60' Quadrangle, West-Central New Mexico. USGS. Geologic Map C-118-A Scale 1:100,000
4. Dubiel, R.F., 1993. Preliminary Geologic Radon Potential Assessment of New Mexico. US Geological Survey Open-File Report 93-292-F.
5. Millard, J.B. and Buggett, D.T., 1984. Radiological Assessment of the Populated Areas Southwest of the Homestake Mining Company Uranium Mill. Radiation Protection Bureau, Environmental Improvement Division, New Mexico Health and Environmental Department.
6. U.S. EPA, Jan. 2010. Aerial Radiological Survey of the Grants and Cebolleta Land Grant Areas in New Mexico. Office of Emergency Management National Decontamination Team. Cincinnati, Ohio.